Genetic technologies offer long and short term views of Ebola dangers

Early this summer, just the Ebola outbreak reached Sierra Leone, scientists at MIT's Broad Institute began hunting through samples sent to them from a colleague treating patients in an over-stretched and under-supplied clinic there. Although the physician, Dr. Humarr Khan, eventually succumbed himself, his work allowed the Broad researchers to develop a portion of the life story of the virus.

From the initial analysis of samples sent to Broad by Kahn, researchers compiled 12 Ebola genomes, each from an infected patient. They were looking both at the lineage of the virus, how it had entered Sierra Leone and how it had changed since it got there, as well as for indications of the rapidity and clinical significance of the mutations that it incurred over the past months, reports Richard Preston at the New Yorker:

> As the virus jumped from person to person, about half the time it had a mutation in it, which caused one of the proteins in the virus to be slightly different. By the time the virus reached Sierra Leone… it had become two genetically distinct swarms. Already, some of the mutations were making Ebola less visible to the tests for it.

What the analysis hasn't told us so far and probably won't in the short term is whether Ebola has the chance to become airborne. This seems to be the question that the media and most of the public concern has centered around. Because the virus can't live in dehydrated moisture particles like the flu virus it's more difficult to transmit from person to person. Eric Lander, who heads the Broad Institute thinks this is the wrong question. Ebola has been infecting humans and transmitting itself using its body fluid method for millions of years. It would be unlikely to switch all at once:

> "That's like asking the question 'Can zebras become airborne,' " [Lander] said. I"That would be like saying that a virus that has evolved to have a certain life style, spreading through direct contact, can evolve all of a sudden to have a totally different life style, spreading in dried form through the air. A better question would be 'Can zebras learn to run faster?' "

And there are more plausible ways it could, Reston reports. If Ebola became less virulent, killing 20 percent of its victims instead of 50, more people would potentially be able to walk around with the virus, increasing the infection rate significantly. Some researchers are discovering the virus in higher concentration in the body fluids of patients. This could indicate that the virus is replicating more efficiently and might make victims more infectious, although that has yet to be proven or investigated in the lab.

A complete picture of the changing ebola genome benefits our long term understanding of the virus and how to stop the current outbreak. It will inform vaccine development, treatment protocols and potentially help us locate the animal resovoiurs that harbor the virus between human outbreaks.

But we need short term solutions as well. Correctly and quickly identifying those who are sick with Ebola rather than a virus that causes similar early symptoms, like the flu, is critical. A Boston University Lab

demonstrated that they can use a paper-based test—think pregnancy test— to identify the virus within an hour.

The test could lead to rapid response, and be cheap enough (between 4 and 65 cents) to be widely used even to test people who might not yet have symptoms but who did have contact with known patients. But, there are still some hangups. The test requires the virus be isolated from a blood sample, which relies on technologies that would probably not be available everywhere.

Another way to curb the current outbreak will involve better surveillance of patients, their whereabouts and personal contacts. Cell phone data provides another way of looking at the disease, at least in countries where the GDP is high enough that phones are mainstream, like Nigeria. The country had a small outbreak but was then able to recover, in part, reports Christopher Mims at the Wall Street Journal, because cellphone companies could collect and share call data for infected patients.

With GPS and call data, healthcare providers can know where and when a person was at any point before they came for medical attention, and contact and isolate potential contacts accordingly. Disease surveillience and the lives it saves is further moral evidence to support connectivity initiatives in Africa, Mims argues. “If we want to stop the next pandemic, connecting the world’s poorest to the most effective communication method ever invented is a good place to start.”

The combination of short-term data through quick diagnostics and cell phone surveillience and our long term knowledge of the genetics of the current outbreak will be vital to stopping it. Experimental vaccine trials are currently underway at the NIH and in Canada. We will need quick accurate, on the ground information to most effectively deploy immunizations to isolated hot spots of infection. The same principles will also apply to treatments. Unfortunately neither scenario is likely to happen within the year.

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Additional Resources:

- Ebola virus response “inadequate” to match new potential mutations, Genetic Literacy Project
- GMO tobacco ‘mystery serum’ rescues Ebola virus victims, Genetic Literacy Project
- Ebola infographic: Is this outbreak poised for pandemic? Nature